Remarks

Consideration of this application in view of the above amendments and following remarks is respectfully requested. Claims 1, 8-10 and 20-28 are now pending. Claims 2-7 and 11-19 have been canceled. Claims 1 and 8-10 have been amended. Claims 20-28 are new.

Priority Claim

This application is a continuation of U.S. Application No. 09/198,323 filed November 24, 1998 (hereinafter "the parent application'). Priority to U.S. Application No. 08/520,333 filed August 25, 1995 (which issued as U.S. Patent No. 5,840,438) is no longer being claimed in this continuation application.

Applicability of 35 U.S.C. §103(c)

This application, having been filed after November 29, 2000, is subject to the "safe harbor" provisions now afforded by 35 U.S.C. §103(c) with regard to potential 35 U.S.C. §102(e) prior art. Accordingly, U.S. Patent No. 5,840,438 to Johnson et al. (hereinafter "the '438 patent") may no longer serve as §102(e) prior art under §103(c) since both the '438 patent and the claimed subject of this application were, at the time the invention was made, owned by the same person, or subject to an obligation of assignment to the same person (*i.e.,* Ballard Power Systems).

Allowability of New Claims 20-28

By final Office Action mailed September 17, 2001 in the parent application, the Examiner indicated that claims 2, 7, 12-17 and 19 contained allowable subject matter, but stood objected to for the reasons of record. To expedite issuance of these claims, Applicants have added new claims 20-28 as discussed below.

At no time during prosecution of the parent application had claims 16-17 been rejected. Thus, Applicants have added new independent claim 20 to parallel claim 16, added new dependent claim 21 (which depends from claim 20) to parallel claim 17, and cancelled claims 16-17.

Similarly, the Examiner indicated that claims 2, 7, 12-15 and 19 also constitute allowable subject matter. Thus, Applicants have added new claims 22-28 which recite these

allowed claims in independent format, and have cancelled claims 2, 7, 12-15 and 19. More specifically, new claim 22 corresponds to allowable claim 2, new claim 23 corresponds to allowable claim 7, new claims 24-27 correspond to allowable claims 12-15, and new claim 28 corresponds to allowable claim 19.

Accordingly, allowance of claims 20-28 is respectfully requested.

Rejection of Claims

By final Office Action mailed September 17, 2001 in the parent application, (a) claims 1, 5, 11 and 18 stood rejected as obvious over U.S. Patent No. 5,702,839 to Frost *et al.* in view of U.S. Patent No. 5,958,613 to Hamada *et al.*; (b) claims 1, 6 and 8 stood rejected as obvious over JP 10-92439 in view of Hamada *et al.*; and (c) claims 1, 3, 4, 6, 9 and 10 stood rejected as obvious over JP 3-222261. Applicants respectfully traverse these rejections for the reasons set forth below.

As an initial matter, and in order to expedite allowance of certain aspects of this invention, Applicants have canceled rejected claims 3-5, 11 and 18. Of course, Applicants reserve the right to continue prosecution of the canceled subject matter in one or more related applications.

In addition, Applicants have amended claim 1 by inclusion of the text of claim 6. In other words, claim 1 has been amended to recite that the fluid transport properties of the first electrode substrate vary as it is traversed in-plane in the direction of the first reaction flow path. In view of this amendment, claim 6 has been canceled and claims 8, 9 and 10 have been amended to depend from claim 1 (as opposed to canceled claim 6).

The only rejections that had been applied to claim 6 in the parent application involve rejections "(b)" and "(c)" above – that is, the rejection of claim 6 as obvious over JP 10-92439 in view of Hamada *et al.*, and as obvious over JP 3-222261. Applicants respectfully traverse these grounds of rejection as applied to amended claim 1 (and claims 8-10 which depend therefrom) for the following reasons.

Rejection Based on JP 10-92439 in view of Hamada *et al.*

JP 10-92439 is published in the Japanese language. However, this patent is a member of a patent family that contains English language equivalents. One such equivalent is GB 2316802 (a copy of which is submitted herewith, along with the DIALOG® printout showing it to be a member of this family). Thus, all further reference to this patent will be to GB 2316802 (hereinafter "GB 802").

GB 802 is directed to a gas diffusion electrode having:

> an anisotropic gas diffusion layer that is made of a porous carbon matrix through which carbon particles and polyethersulfone are distributed such that the matrix is homogeneously porous in a direction lateral to gas flow and asymmetrically porous to gases in the direction of gas flow, the porosity of the gas diffusion layer decreasing in the direction of gas flow, ...

See GB 802 at page 10, lines 15-21 (emphasis added).

In the Office Action issued in the parent application, the Examiner understood the above language to teach that "the porosity of the substrate is 'lowered' toward the end of the gas flow." (9/17/01 Office Action at page 3). This is opposite to what GB 802 actually teaches. Rather, the porosity of the GB 802 matrix is *homogenous* as it is traversed in-plane to the direction of the reactant flow path, and *asymetrical* through the matrix. Confusion regarding this point appears to lie in the phrases "lateral to gas flow" and "direction of gas flow". As used in claim 1 of the pending application, the phrase "direction of gas flow" means from the first port to the second port such that the flow path extends in-plane across the electrochemically active area. In contrast, the phrase "direction of gas flow" as used in GB 802 means gas flow through the electrode matrix, from one face to the other.

This direction of flow is evident upon reference to page 22, lines 7-16, of GB 802. This portion of GB 802 clarifies that the direction of gas flow, after entering the electrode, is through the less resistant surface and toward the more dense portion of the matrix. Thus, as stated at page 22, lines 13-15, "the electrode matrix of the [GB 802] invention has an anisotropic porous structure with two asymmetric surface layers ..." These asymmetric surface layers yield a matrix that is "asymmetrically porous" to gases in the direction of gas flow (*i.e.,* through the matrix), but "homogenously porous" in the direction lateral to gas flow (*i.e.,* across the matrix).

As the Examiner will appreciate, this is directly contrary to the subject matter recited in claim 1 with regard to flow across the matrix.

Therefore, GB 802 does not teach or suggest the invention as recited in claim 1. The addition of Hamada *et al.* does not cure this deficiency since it is entirely silent on the issue.

Accordingly, Applicants respectfully submit that amended claim 1, as well as dependent claims 8-10, are patentable in view of GB 802, and request that this ground of rejection be withdrawn.

<u>Rejection Based on JP 3-222261</u>

As with the Japanese patent document discussed in the prior section, JP 3-222261 is also in the Japanese language. Since Applicants were unable to locate an English language equivalent of this document, an English language translation has now been obtained. A copy of the translation is submitted herewith, and all further reference to JP 3-222261 will be to the English language translation (hereinafter "JP 261").

As an initial matter, JP 261 is directed to a solid electrolyte (*e.g.*, stabilized zirconia) fuel cell that is quite different, in both principle and operation, from the membrane or polymer electrolyte fuel cell (PEFC) of this application. Thus, Applicants respectfully submit that, although the disclosure of JP 261 is to a "fuel cell", it does not constitute analogous art to a PEFC. For example, a PEFC typically operates at a temperature of about 80°C, while a solid electrolyte fuel cell (such as that disclosed in JP 261) has typical operating temperatures ranging from 800 – 1,000°C. Further, in a solid electrolyte fuel cell, mass-transfer conditions may largely be ignored due to the higher reactant and product diffusivities.

With these differences in mind, the problem to be solved in JP 261 had to do with thermal stress attributable to heat (due to uneven current) being produced in a nonuniform manner which, in turn, was caused by an abundance of fuel near the fuel gas inlets and shortage of fuel near the outlets (*see* JP 261 at bottom of page 5 and top of page 6). To solve this problem, the "fuel electrode" (*i.e.,* the anode) purportedly had an area of low porosity near the fuel inlets (*see* Figure 2 of JP 261). By designing the anode in this manner uniform temperature distribution could be obtained, thus providing the solid electrolyte fuel cell extended life and other benefits noted in JP 261 (*see* top of page 10).

As the Examiner will appreciate, the problems inherent in a solid electrolyte fuel cell do not necessarily present themselves in a PEFC. In particular, the thermal uniformity that was sought in the JP 261 patent is not necessarily advantageous in a PEFC. Rather, in a PEFC water management on the cathode side of the membrane electrode assembly (MEA) is important in avoiding performance loss, and such fuel cells are beneficially operated with a temperature gradient increasing from the inlet port to the outlet port. As a consequence, the additional water produced along the path from the inlet to the outlet is mitigated by the increased amount of water vapor that the stream can carry due to the temperature rise (*see* paragraph spanning pages 103-104 and Figure 6 in St-Pierre et al., "Relationships Between Water Management, Contamination and Lifetime Degradation in PEFC," *J. New Materials for Electrochem. Systems 3*:99-106, 2000) (copy attached). Thus, maintaining a temperature gradient is actually a desired attribute in the design of the cathode for a PEFC for reasons related to mass transport, while the solid electrolyte fuel cell of JP 261 sought to eliminate any such temperature gradient by modification of the anode.

To further clarify this distinguishing feature, Applicants have amended claim 1 to recite that "said first electrode is a cathode." By this amendment, claim 1 recites that the fluid transport properties (*e.g.,* porosity) of the first electrode – that is, the cathode - vary as it is traversed in-plane in the direction of the first reactant flow path. This aspect of claim 1 is not taught or suggested by JP 261. Furthermore, one skilled in this field would not be motivated to make such a modification since the very reason for lowering porosity near the fuel inlet in JP 261 was to yield uniform temperature distribution, as opposed to addressing mass transport considerations at the cathode of a PEFC.

Accordingly, Applicants respectfully submit that claim 1, as well as dependent claims 8-10, are patentable over JP 261 and request that this ground of rejection also be withdrawn.

Attached is a Supplemental Information Disclosure Statement, along with completed PTO Form 1449, listing the references identified and discussed herein.

Also attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "**Version With Markings to Show Changes Made.**"

In view of the above amendment and remarks, allowance of claims 1, 8-10 and 20-28 is respectfully requested. A good faith effort has been made to place this application in condition for allowance. However, should any further issue require attention prior to allowance, the Examiner is requested to contact the undersigned at (206) 622-4900 to resolve the same.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

Claims 2-7 and 11-19 have been canceled.

Claims 1 and 8-10 have been amended as follows:

1. (Amended) An electrochemical fuel cell assembly comprising:

a first separator plate having a pair of oppositely facing major planar surfaces, and first and second ports;

a second separator plate having a pair of oppositely facing major planar surfaces, and third and fourth ports;

a membrane electrolyte interposed between said first and second separator plates;

a first electrode interposed between said first plate and said membrane electrolyte, said first electrode comprising a first substrate having a pair of oppositely facing major planar surfaces and electrocatalyst associated therewith defining a first electrochemically active area; and

a second electrode interposed between said second separator plate and said membrane electrolyte, said second electrode comprising a substrate having a pair of oppositely facing major planar surfaces and electrocatalyst associated therewith defining a second electrochemically active area;

said electrochemical fuel cell assembly further comprising a first reactant flow path for directing a first reactant fluid stream between said first and second ports, wherein said first reactant flow path extends substantially linearly across said first electrochemically active area, and a fluid transport property of said first electrode ~~has an in-plane nonuniform structure in its electrochemically active area as said active area~~ substrate varies as it is traversed in-plane in the direction of said first reactant flow path, and wherein said first electrode is a cathode.

8. (Amended) The electrochemical fuel cell assembly of claim 1 [6] wherein the density of said first electrode substrate increases as it is traversed in-plane in the direction of said first reactant flow path.

9. (Amended) The electrochemical fuel cell assembly of claim 1 [6] wherein the porosity of said first electrode substrate increases as it is traversed in-plane in the direction of said first reactant flow path.

10. (Amended) The electrochemical fuel cell assembly of claim 1 [6] wherein the pore size of said first electrode substrate increases as it is traversed in-plane in the direction of said first reactant flow path.

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